## REMARKS

Applicants hereby request reconsideration of the Final Rejection in view of the following comments.

There is a very significant and patentable difference between the articles disclosed in the prior art White '945 and Alexander '076 patents and the articles claimed herein by applicants – the water permeability of the articles claimed herein versus the water-permeability (a maximum permeability of 1 x $10^{-7}$ cm/sec) of the water-mpermeable articles described in the White '945 and the Alexander patent 5,043,076. The water-permeability achieved by the methods of manufacturing the articles claimed herein is on the order of 1 x $10^{-2}$ cm/sec to 1 x $10^{-3}$ cm/sec so that sufficient water passes through the article for treatment by the reactive material contained therein. This permeability is achieved by providing a preformed mat having an apparent opening size (pores) in the range of about 0.5 mm to about 6 mm that are subsequently filled with the powered or reactive material, as claimed. While the White '945 patent describes a process for manufacture that simultaneously deposits fiber and water-swellable clay for filling the fiber with the water-swellable clay and, therefore, has sufficiently high loft during the initial stage of manufacture to meet applicant's claimed opening size, the high loft mat must then be compressed and consolidated at rollers 36, 38 (Fig. 1) and subsequently needle-punched together at 40 (Fig. 1) such that the final product not only has sufficient sodium bentonite clay across its entire area for water-impermeability, but also does not contain the claimed apparent opening size sufficient to provide the water-permeability needed for sufficient flow of water through the mat for water-purification purposes.

## WHITE '945 AND ALEXANDER '076 WATER-IMPERMEABILITY

The Final Rejection refers to column 4, lines 40-63 of the White '945 patent as a teaching of porosity. In fact, this section of the White '945 patent is directed to omitting the water-swellable clay "throughout a predetermined thickness at the **top** major surface, **bottom** major surface or along an **intermediate** three-dimensional thickness of the finished article to permit lateral gas venting"

It is quite clear throughout the entire White '945 patent that no vertical porosity is intended (only lateral gas porosity). For example:

Column 3, lines 11 and 12: "a bentonite clay-filled water barrier fabric"

Column 3, lines 46-49: "the application of layer(s) of water-impermeable ... sealing material(s) over one or both major surfaces of the article as a safety or secondary layer of water-impermeability"

Column 6, lines 42-45: "waterproofing membrane capable of holding water disposed above the membrane such that water permeates the membrane at a rate of $1 \times 10^{-7}$ cm/sec or less"

Column 7, line 64: "a bentonite clay-filled water barrier"

Column 19, line 64: "retaining the desired water barrier characteristics"

Abstract, line 1: "water barrier fabric"

The '076 patent, like the White '945 patent, is designed to be a water-impermeable membrane that allows the permeation of waste water at a maximum rate of $1 \times 10^{-7}$ cm/sec and provides a feature that this tiny amount of water that **may** permeate the membrane will be treated by a reactive material contained by the membrane. As shown in Fig. 1, "the water-impermeable upper plastic sheet layer 20 is a water-holding layer that permits $1 \times 10^{-7}$ cm/sec or less of the contaminated water to pass therethrough" (column 7, last two lines, column 8, lines 1-2). As set forth in the '076 patent at column 4, lines 4-6, the material intended for use in the article described in this patent meet environmental specifications which generally call for a material having a water permeation rate of $1 \times 10^{-7}$ cm/sec or less. This environmental standard is shown in the attached Exhibit A, "The Permeability of Soil" from Foundation Engineering, Second Edition, page 43. Clearly, the articles described in the White '945 patent as well as the articles described in the Alexander '076 patent are intended to provide a water-impermeable layer as a water barrier. The Alexander '076 patent recognizes that this very slight permeation of contaminated water ($1 \times 10^{-7}$ cm/sec or less) may contaminate ground water and, therefore, there is provided a

layer of contaminant reactant material in the event that some slight amount of water may escape through the liner.

Applicants claimed article and method of manufacturing provides for a water-permeable article that provides at least five more magnitudes of permeability than that described in the White '945 and Alexander '076 patents by providing an apparent opening size of 0.5 mm to 6 mm in the high loft mat being filled with the contaminant reactive material. It has been found that these articles are excellent for environments such as the Anacostia River that have an underflow of water entering the river and this flow can pass through the claimed articles to remove contaminants without disturbing the placement of the claimed article for further treatment of additional water flow into the river. This would not be possible with the articles described in the White '945 or Alexander '076 patents since these articles are water-impermeable or almost water-impermeable and any groundwater attempting to pass through such articles at normal flow would move such articles out of their intended location and would be worthless for filtering or removing any contaminants contained in the water.

It is submitted that it would not have been obvious to one skilled in the art to provide the apparent opening size claimed by Applicants into the articles described in the White '945 or Alexander '076 patents since these patents are directed to providing water-impermeable barriers. **While the Alexander '076 patent provides for treatment of a very tiny amount of water that may or may not traverse the barrier, the article is intended to hold or contain water over a predetermined land area, such as a waste water lagoon, and one of ordinary skill in the art would not provide such a material with greater permeability for a greater threat of groundwater contamination**. The Alexander '076 materials are clearly intended to be water-impermeable, but in the event of any leakage, provides a reactant material to prevent that leakage from reaching groundwater. One skilled in the art would certainly not intentionally provide greater permeability to such a membrane.

Applicants have found that providing the permeability claimed, the resulting article can be used as was used at the Anacostia River to allow contaminated water supplies to pass there through while removing the contaminants at a rate substantially greater than that permitted by the articles described in the White '945 and Alexander '076 patents. There is no

motivation or suggestion in either the White '945 or Alexander '076 patents to provide the membrane 10 (Alexander '076) with a permeability greater than 1 x $10^{-7}$ cm/sec. In fact, when containing contaminated water above land, such as in a wastewater lagoon, those skilled in the art provide as much water-impermeability as economically feasible since groundwater contamination has dire consequences.

For the above-reasons it is submitted that the Final Rejection should be withdrawn. It is submitted that all claims are now of proper form and scope for allowance. Early and favorable consideration is respectfully requested.

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Respectfully submitted,

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Table 2.1 **Coefficient of Permeability of Various Soils**

| k (cm/sec) | Drainage | Soil Type | Determination of k |
|---|---|---|---|
| $10^2$<br>$10^1$ | Good<br>Good | Clean gravels<br>Clean gravels | Pumping tests. Reliable if properly conducted; Constant head permeameter-reliable; Computation from grain size |
| 1.0 | Good | Clean sands | Pumping tests. Reliable if properly conducted; Constant head permeameter-reliable; Falling-head permeameter: Reliable; Computation from grain size |
| $10^{-1}$<br>$10^{-2}$<br>$10^{-3}$<br>$10^{-4}$ | Good<br>Good<br>Good<br>Good | Clean sand and gravel mixtures | Pumping tests. Reliable if properly conducted; Constant head permeameter-reliable; Falling-head permeameter: Reliable; Computation from grain size |
| $10^{-5}$<br>$10^{-6}$ | Poor<br>Poor | Very fine sands<br>Organic and inorganic silts, mixtures of sand silt and clay, glacial till, stratified clay deposits. | Falling-head permeameter: Unstable. Much experience required |
| [illegible] | [illegible] | Impervious soils, for example, homogeneous clays below zone of weathering. | Falling-head permeameter: Fairly reliable; Computation from consolidation data (reliable) |

After Casagrande and Fadum (1940).

in which $q$ equals the rate of flow across the boundary of any cylindrical section having a radius $r$ and, therefore, the quantity of water pumped from the well per unit of time.

Approximate values of the coefficient of permeability for various types of soils and the recommended method of determining these values are assembled in Table 2.1. As the table indicates, it is difficult to obtain reliable values for the coefficient of permeability of soils that contain appreciable quantities of silt or very fine sand. There is no indirect method of computing the permeability of such materials, and laboratory tests are likely to be extremely unreliable unless made by experienced technicians.

## ILLUSTRATIVE PROBLEMS

1. A loose uniform sand with rounded grains has an effective grain size $D_{10}$ equal to 0.3 mm. Estimate the coefficient of permeability.

*Solution.* The estimate can be made by means of eq. 2.4. Thus,

$$k = CD_{10}^2 = 100 \times (0.03)^2$$
$$= 9 \times 10^{-2} \text{ cm/sec}$$

2. In a constant-head permeability test a sample 8 cm long was tested in a permeameter with an inside diameter of 5 cm. After a state of steady flow was established under a head of 50 cm, a discharge of 120 cu cm was collected in 30 sec. Compute the value of $k$.

*Solution.* According to eq. 2.5,

$$k = \frac{QL}{hAt} = \frac{120 \times 8}{50 \times \pi \times \frac{25}{4} \times 30}$$
$$= 3.3 \times 10^{-2} \text{ cm/sec}$$

3. A falling-head permeability test was performed in a permeameter with an inside diameter of 5 cm. The inside diameter of the standpipe was 2 mm. The sample had a length of 8 cm. During a period of 6 min